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Washington, D. C. 20231

Enclosed herewith for filing is a patent application, as follows:

Inventor: Rodric C. Fan

Title: Location-Specific In-Vehicle Frequency Tuning Data

X	Return Receipt Postcard;
X	This Transmittal Letter (in duplicate);
9	pages Specification (not including claims);
5	pages Claims;
1	page Abstract;
2	Sheets of Drawings (Figs. 1, 2, 3);
2	pages Declaration For Patent Application and Power of Attorney (signed by Rodric C. Fan);
1	page Recordation Form Cover Sheet (in duplicate); and
1	page Assignment (signed by Rodric C. Fan).

CLAIMS AS FILED

For	Number Filed			Number Extra		Rate			Basic Fee
								$	710.00
Total Claims	32	-20	=	12	x	$ 18.00	=	$	216.00
Independent Claims	4	-3	=	1	x	$80	=	$	80.00
☐ Fee of ____ for the first filing of one or more multiple dependent claims per application								$	
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LOCATION-SPECIFIC IN-VEHICLE FREQUENCY TUNING DATA

Rodric C. Fan

BACKGROUND

1. Field of the invention

Embodiments pertain to in-vehicle radio frequency signal reception, and more particularly to providing signal tuning information for signal reception areas in which the vehicle is located.

2. Related art

Many motor vehicles (e.g., automobiles, trucks) are equipped with radio receivers that receive radio signals from commercial radio broadcast stations (e.g., AM, FM). These radio receivers are typically equipped with means (e.g., conventional pushbuttons located on the receiver's front panel) that allow a radio listener to select one of several preselected radio frequencies for tuning and listening to content carried by the signal. At a particular geographic position, therefore, the listener may choose among several preselected commercial radio broadcast stations whose radio signal reception areas encompass the receiver's position. FIG. 1 illustrates motor vehicle 10 operating within reception area 12 of a signal broadcast by commercial broadcast transmitter 14. When in reception area 12, an occupant of vehicle 10 presses a pushbutton to select the signal frequency of transmitter 14.

Since the number of available preselected tuning frequencies is typically limited, when a motor vehicle is moved outside the signal reception areas of the broadcast stations whose frequencies have been preselected by the listener, the listener must then manually select broadcast signal frequencies for new signal reception areas. As illustrated in FIG. 1, for

example, as vehicle 10 travels (depicted by the arrow) beyond reception area 12, the listener must find (e.g., manually tune or use a frequency scanning feature) frequencies in coverage areas 16 and 18 in order to receive signals from transmitters 20 and 22, respectively.

It is often difficult for a listener operating a vehicle outside of a home listening area (e.g., area 12) to discover one or more commercial radio stations that broadcast subject matter in which the listener is interested. While many in-vehicle radio receivers have a frequency scan feature, this feature often does not lock on to low power broadcast station signals, or to signals in acceptable but weak signal reception areas. Or, the scan feature locks on to a station during broadcast of an advertisement or other non-content related subject, so that the listener is unable to determine the commercial broadcast content format (e.g., rock and roll music, classical music, news) of the locked-on signal. A listener traveling in vehicle 10 who normally listens to classical music in home reception area 12 must then tune to many different frequencies in reception areas 16,18 in order to continue listening to, for example, classical music. Similarly, a listener who travels to reception area 18 and who wants to receive local information (e.g., motor vehicle traffic information for highways within area 18) will have a difficult time determining which broadcast stations within area 18 transmit such local information. It is therefore desirable to provide a way for a motor vehicle radio listener to determine what radio frequencies are available at a particular geographic location, and furthermore to identify stations that broadcast in certain subject format categories at the location.

SUMMARY

A radio signal receiving system includes a location unit, a frequency selection unit, and a receiving unit. Radio signal

tuning data is loaded into the selection unit. The tuning data includes data for tuning to particular radio signal frequencies and the reception area for each signal. The location unit determines the receiving system's geographic position and passes the position information to the frequency selection unit. The selection unit then determines in which radio signal reception areas the system is located. In some embodiments the tuning information is grouped by radio signal content categories such that the selection unit may select tunable frequencies in one or more particular content categories as the system is moved through changing signal reception areas. In some embodiments the tunable content categories, and/or information about the tunable signals, are output as a menu for listener selection. In other embodiments, tuning to receive a particular content category is automatic upon reaching a new reception area.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic plan view of several radio signal reception areas.

FIG. 2 is a diagrammatic view of an embodiment of the invention.

FIG. 3 is a diagrammatic perspective view of several satellite radio signal reception areas.

DETAILED DESCRIPTION

FIG. 2 is a functional block diagram of an embodiment of the invention. As depicted in FIG. 2, receiving system 100 is positioned in a motor vehicle, represented by dashed line 101. System 100 includes location unit 102, frequency selection unit 104, receiving unit 106, and listener interface 108.

In some embodiments location unit 102 is a conventional global positioning system (GPS) receiver that receives signals 110 from satellites in GPS constellation 112. Signals 110 include pseudo-range information that location

unit 102 uses to conventionally determine the geographic position of system 100. Information 114 identifying system 100's position is output from location unit 102 to frequency selection unit 104. In other embodiments location unit 102 determines geographic position by using corrected GPS information received from local GPS correction stations (not shown). U.S. Patent No. 5,959,577 discloses the use of GPS correction stations and is incorporated herein by reference. In still other embodiments location unit 102 determines geographic position by using conventional information in a signal received from conventional cellular wireless (radio) communications system tower 116. For example, a conventional cellular telephone handset (not shown) is electrically coupled to location unit 102 so that unit 102 receives and/or determines position information from signals transmitted by cellular communications system antenna tower 116. In this instance, system 100's location is determined to be within the signal reception area of signals transmitted from tower 116.

Selection unit 104 receives position information 114 from location unit 102. Selection unit 104 also receives frequency tuning data 120 from database 122 and stores the data 120 in conventional memory 124. Tuning data 120 is described in detail below. Various procedures are used to transfer (download) tuning data 120 from database 122 to memory 124. For example, in some instances the information is transferred using a conventional direct wired electrical connection (e.g., coupled to a computer via a cable). In other instances tuning data 120 is transferred via a conventional link through the Internet (network of interconnected networks having its origin in research done by the United States Advanced Research Projects Agency). Frequency selection unit 104 includes a conventional microprocessor/microcontroller and, as described below, uses position information 114 and tuning data 120 to select the frequency of a transmitter having a signal reception area within

which system 100 is positioned. Programming to control selection unit 104, as well as units 102, 106, and 108, is routing in light of this specification.

Selection unit 104 outputs selected frequency data 126 to receiving unit 106. In the embodiment shown in FIG. 2, conventional frequency synthesizer 128 uses data 126 so that receiving unit 106 properly tunes to receive the selected content-containing radio signal 129a. Receiving unit 106 extracts the content from signal 129a and outputs the content to the listener as audio program 129b.

In some embodiments selection unit 104 receives one or more listener commands 130 from listener interface 108. Commands 130 are made in response to selected information 132 output on interface 108, such as a broadcast subject category menu, received by interface 108 from selection unit 104.

TABLE I shows an illustrative embodiment of frequency tuning data 120. As shown in TABLE I, tuning data 120 is arranged by subject content category and by geographic area. The content categories are illustrative of many possible categories. The "xxx.x" represents one of many possible radio frequencies, such as one of the 101 available U.S. commercial FM radio frequencies. The frequencies are not limited to signals having one particular transmission form, but may refer to several broadcast forms such as commercial FM radio, AM radio, government weather reports, or other broadcast services operating in frequency spectra such as television separate audio programming or sidebands of commercial radio broadcast transmission frequencies.

TABLE I

	Content Category			
Geo. Area	Classical	Rock & Roll	Traffic	Weather
A (12)	xxx.x xxx.x	xxx.x xxx.x xxx.x	xxx.x	xxx.x
B (16)	xxx.x	xxx.x xxx.x xxx.x	xxx.x	-
C (18)	xxx.x xxx.x	xxx.x	-	xxx.x

The geographic area is the transmission signal coverage area. In some cases the geographic area is circular, centered on the broadcast antenna location, with a radius that is determined by the power of the broadcast transmitter. In other cases, such as for satellite transmissions discussed below, the circular geographic area is centered on the ground aim point of the satellite antenna. In other cases the geographic area is a more complex shape, determined for example by actual field measurement of broadcast signal reception.

As shown in TABLE I, classical music is available on two frequencies in geographic area A, rock & roll music on three frequencies, local (i.e., relevant to area A) motor vehicle traffic information on one frequency, and local weather information on one frequency. In geographic area B, classical music is available on one frequency, rock & roll music on three frequencies, local (i.e., relevant to area B) motor vehicle traffic information on one frequency, but no local weather information is available. In geographic area C, classical music is available on two frequencies, rock & roll music on one frequency, local (i.e., relevant to area C) weather information on one frequency, but no local motor vehicle traffic information is available. Particular frequencies may be listed in more than one content category (e.g., both "Rock & Roll" and "Pop Music" categories), depending on a station's particular program content format.

Referring again to FIG. 1 and continuing this example of tuning data 120, TABLE I geographic area A corresponds to broadcast reception area 12, area B to 16, and area C to 18. System 100 provides the occupant of motor vehicle 10 who wants to listen to classical music while traveling through areas 12,16,18 with classical music signal tuning information in all three areas 12,16,18. While in reception area 12, selection unit 104 (FIG. 2) outputs the two area 12 classical music frequencies as selected information 132. The listener inputs a command 130 to selection unit 104 which, in response to the command, outputs selected tuning data 126 to receiving unit 106. Receiving unit 106 then tunes to the selected frequency and outputs the signal content to the listener. Similarly, in reception area 16 the one classical music frequency is made available for selection and is output as data 126. And likewise in reception area 18, the two available classical music frequencies are made available for selection, and the selected frequency is output as data 126. Frequency tuning for the other content categories is similarly made available for selection as vehicle 10 passes through areas 12,16,18.

In some embodiments the broadcast content categories made available in frequency tuning data 120 are customized to a particular user preference. For example, a particular user accesses via the Internet a site on the world-wide-web that includes many content categories for the radio signal reception areas. The particular user selects one or more content categories of interest (e.g., classical music, local traffic information, local weather information) on the web site. The frequency tuning information is then formatted (using, e.g., a conventional server associated with the web site) and downloaded as data 120.

Available content categories are output using interface 108 as, for example, a menu of categories. In some embodiments the output is made using a conventional visual display (e.g., liquid

crystal) while in other embodiments the output is audible using a conventional audio output (e.g., synthesized or digitally recorded speech). The user then selects the content category he or she wishes to tune by using, for example, manual pushbutton inputs or verbal commands received by a conventional voice recognition system included in interface 108. This selection is output to selection unit 104 as command 130.

In some embodiments interface 108 also outputs as a menu the particular available frequencies for the reception area in which system 100 is currently located. Thus the listener may select among the available frequencies for a particular content category by using, as before, manual or verbal commands that are transformed and output as command 130. In some embodiments tuning data 120 includes a brief description giving more specific broadcast format information for each available frequency. Thus when the listener selects, for example, the rock & roll content category, interface 108 outputs to the user that one rock & roll broadcast station format is "classic rock," another station is "oldies," and still another station format is "modern rock." Thus available frequencies in one or more particular content categories may be continuously updated for listener selection.

In other embodiments, however, when system 100 leaves one signal reception area in which the listener is receiving output in a particular content category, selection unit 104 automatically selects a frequency in the same particular content category when entering the new signal reception area. Thus the listener continuously receives output in a particular content category. Tuning to new signals in some instances may be prompted by geographic position, or in other instances by received signal strength. One particularly worthwhile application of this automatic tuning feature is providing localized (e.g., within cellular communications cells near the listener's position) coverage area motor vehicle traffic

information to drivers. Drivers entering a city from one direction, for example, are typically unconcerned with traffic conditions on the opposite side of the city. Thus by using system 100 a driver may receive vehicle traffic information within, for example, 30 minutes of driving time from the present location.

Some embodiments of this invention are used to provide frequency tuning data for commercial direct satellite broadcast. Referring to FIG. 3, communications satellite 150 broadcasts on one or more radio frequencies for wide geographic reception area 151 on the surface of the earth 152. Satellite 150 also transmits three "spot" radio frequency beams aimed at different points on the earth 152. These spot beams carry, for example, information relevant to the small frequency reception area on the earth. As shown in FIG. 3, radio frequency beam 154 has reception area 156, beam 158 has reception area 160, and beam 162 has reception area 164. Reception areas 156,160 are adjacent, and so the beams 154,158 frequencies are different to prevent signal interference. Reception area 164 is distant from reception area 156, and so beams 154,162 may have the same radio frequency. Motor vehicle 10 receives tuning information for beams 154,158,162 as it travels through reception areas 156,160,164, respectively, as well as tuning information for area 151.

The present invention is not limited to the specific embodiments discussed above. For example, other embodiments may be used to provide coverage for maritime vessels or aircraft. Furthermore, embodiments are not limited to receiving audio information, but may be used to receive, for example, video, text, or information for synthesized speech output.

CLAIMS

I claim:

1. A radio signal receiving system comprising:

a location unit;

a frequency selection unit coupled to receive global positioning system derived position information from the location unit; and

a receiving unit coupled to receive from the selection unit data for tuning a particular frequency, wherein the particular frequency is associated with a radio signal reception area that encompasses the system position.

2. The system of claim 1 wherein the frequency is the transmission frequency of a frequency modulated (FM) broadcast station.

3. The system of claim 1 wherein the frequency is the transmission frequency of a satellite transmitter.

4. The system of claim 1 further comprising a user interface electrically coupled to receive from the selection unit data arranged as radio signal content categories, and to output a menu of the categories to a listener.

5. The system of claim 4 wherein at least a portion of the menu is output on a visual display.

6. The system of claim 4 wherein at least a portion of the menu is audibly output by the interface.

7. The system of claim 1 further comprising a user interface electrically coupled to receive and relay to the selection unit a user command to select a particular content category in an

arrangement of radio signal content categories stored in the selection unit.

8. The system of claim 7 wherein the command is a verbal command.

9. A radio signal receiving system comprising:

a location unit;

a frequency selection unit coupled to receive cellular wireless communication system derived position information from the location unit; and

a receiving unit coupled to receive from the selection unit data for tuning a particular frequency, wherein the particular frequency is associated with a radio signal reception area that encompasses the system position.

10. The system of claim 9 wherein the frequency is the transmission frequency of a frequency modulated (FM) broadcast station.

11. The system of claim 9 wherein the frequency is the transmission frequency of a satellite transmitter.

12. The system of claim 9 further comprising a user interface electrically coupled to receive from the selection unit data arranged as radio signal content categories, and to output a menu of the categories to a listener.

13. The system of claim 12 wherein at least a portion of the menu is output on a visual display.

14. The system of claim 12 wherein at least a portion of the menu is audibly output by the interface.

15. The system of claim 9 further comprising a user interface electrically coupled to receive and relay to the selection unit a user command to select a particular content category in an arrangement of radio signal content categories stored in the selection unit.

16. The system of claim 15 wherein the command is a verbal command.

17. A method of tuning a mobile radio system, comprising the acts of:

providing frequency tuning data to the system;

providing location information to the system, wherein the location information identifies a current position of the system;

selecting particular data for a particular frequency from the tuning data, wherein the particular frequency is associated with a reception area of a radio signal, and wherein the reception area encompasses the position of the system; and

using the selected data to tune and receive the radio signal.

18. The method of claim 17, wherein the frequency tuning data comprises information used to tune to frequency modulated (FM) radio station frequencies.

19. The method of claim 17, wherein the frequency tuning data comprises information used to tune to satellite transmission radio frequencies.

20. The method of claim 17, wherein the frequency tuning data is arranged in categories of content carried by radio signals.

21. The method of claim 20 further comprising the act of outputting to a user a menu of content categories available for the current position.

22. The method of claim 20 further comprising the act of receiving a command from a listener to select a particular content category.

23. The method of claim 17, wherein providing the frequency tuning data comprises a system user selecting one or more content categories via the Internet and downloading via the Internet to the system the tuning data for the selected categories.

24. The method of claim 23, wherein the user selects the one or more content categories via the World-Wide Web.

25. The method of claim 17, wherein the location information is provided using global positioning system information.

26. The method of claim 17, wherein the location information is provided using cellular wireless communications system information.

27. A method of tuning a mobile radio system, comprising the acts of:

providing frequency tuning data to the system;

providing location information to the system, wherein the location information identifies a current position of the system;

selecting data for tuning a first particular frequency from the tuning data, wherein the first particular frequency is associated with a first radio signal reception area that encompasses a first position of the system; and

when the current position becomes a second position of the system, automatically selecting data for tuning a second particular frequency from the tuning data, wherein the second particular frequency is associated with a second radio signal reception area that encompasses the second position of the system.

28. The method of claim 27, wherein the frequency tuning data is arranged in categories of content carried by radio signals, and the data for the second particular frequency is in the same content category as the data for the first particular frequency.

29. The method of claim 27, wherein the frequency tuning data comprises information used to tune to frequency modulated (FM) radio station frequencies.

30. The method of claim 27, wherein the frequency tuning data comprises information used to tune to satellite transmission radio frequencies.

31. The method of claim 27, wherein the location information is provided using global positioning system information.

32. The method of claim 27, wherein the location information is provided using cellular wireless communications system information.

LOCATION-SPECIFIC IN-VEHICLE FREQUENCY TUNING DATA

Rodric C. Fan

ABSTRACT

An in-vehicle system comprises a location unit, a frequency selection unit, and a receiving unit. Frequency tuning data is loaded into the selection unit. The frequency tuning data includes a radio signal reception area for each unique frequency in the tuning data. The location unit determines the system location and passes the location information to the frequency selection unit. The selection unit selects tuning data for a particular frequency having a signal reception area that encompasses the present vehicle location, and passes the selected data to the receiving unit. The receiving unit uses the selected tuning data to tune the radio signal.

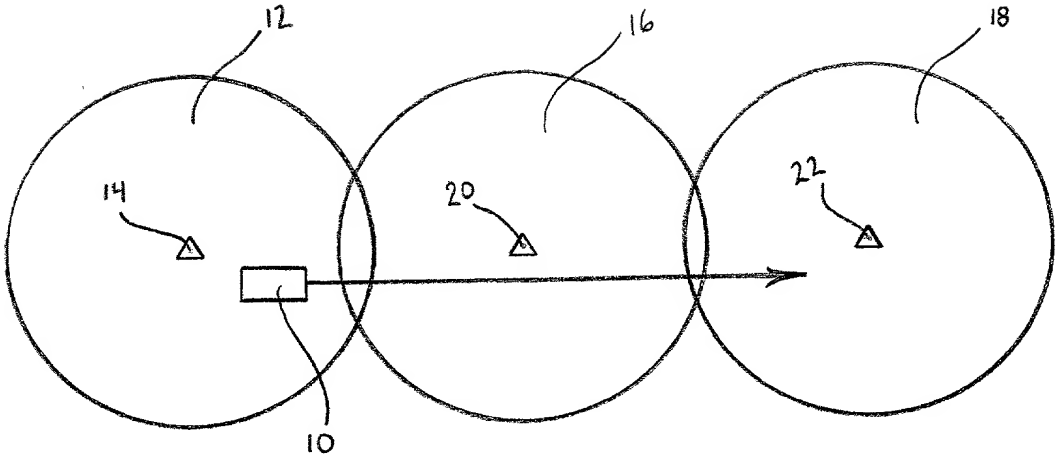
12
16
18
14
20
22
10

FIG. 1

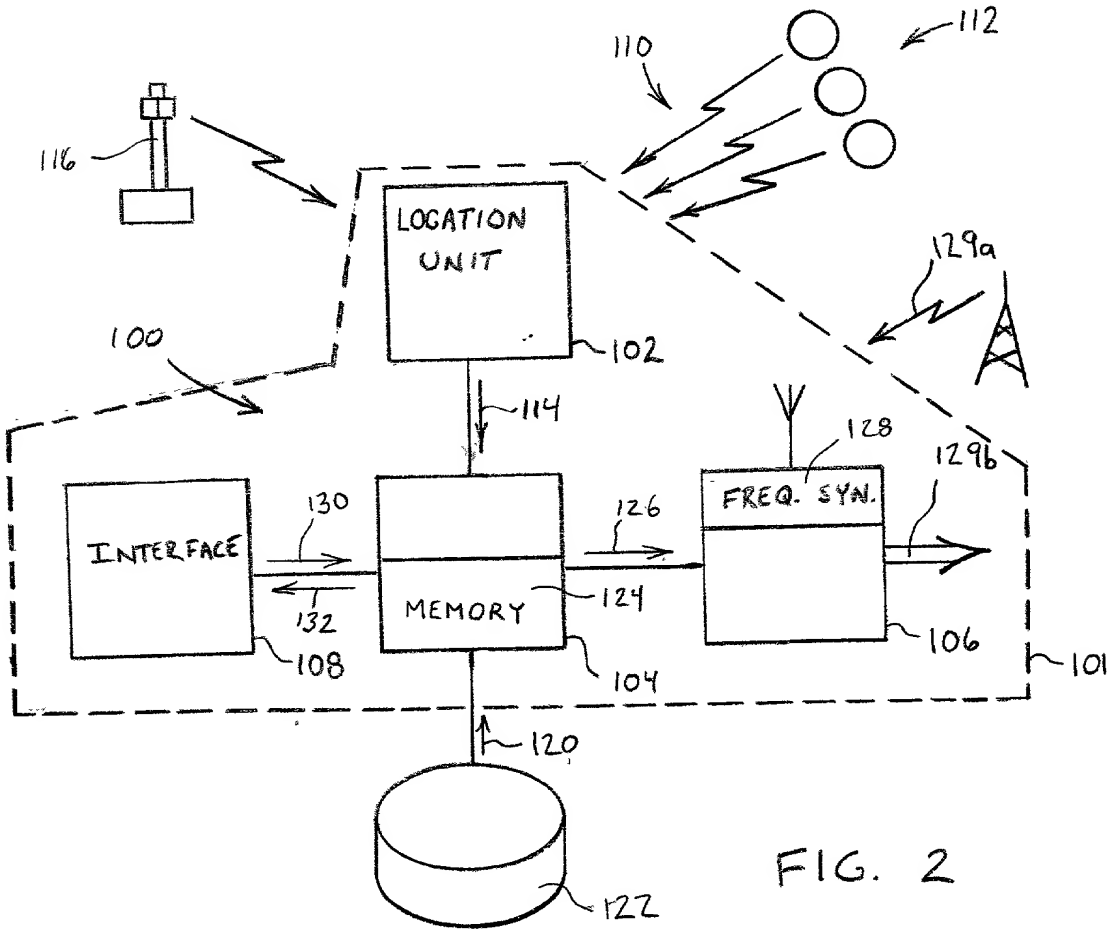
112
110
116
LOCATION UNIT
102
129a
100
114
128
129b
INTERFACE
130
126
FREQ. SYN.
MEMORY
124
132
108
104
106
101
120
122

FIG. 2

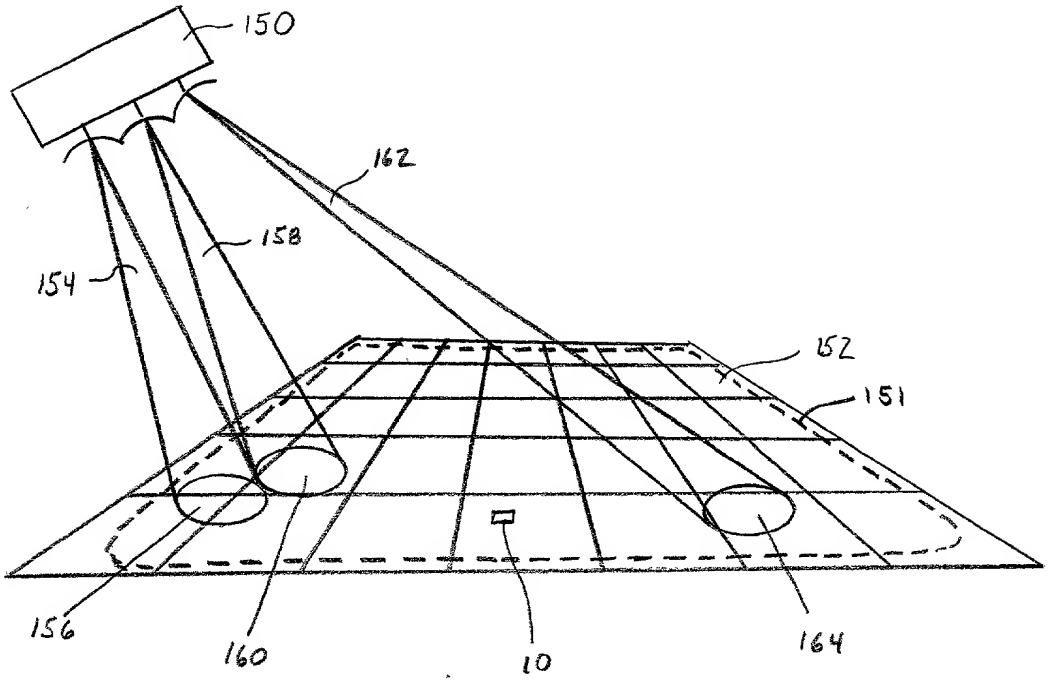

FIG. 3

DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below adjacent to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of subject matter (process, machine, manufacture, or composition of matter, or an improvement thereof) which is claimed and for which a patent is sought by way of the application entitled

Location-Specific In-Vehicle Frequency Tuning Data

which (check)
- ☒ is attached hereto.
- ☐ and is amended by the Preliminary Amendment attached hereto.
- ☐ was filed on as Application Serial No.
- ☐ and was amended on (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
Number	Country	Day/Month/Year Filed	Yes	No
N/A			☐	☐

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

Provisional Application Number	Filing Date
N/A	

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or PCT international application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information, which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56, which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application:

Application Serial No.	Filing Date	Status (patented, pending, abandoned)
N/A		

I hereby appoint the following practitioners to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith:

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I declare that all statements made herein of my own knowledge are true, all statements made herein on information and belief are believed to be true, and all statements made herein are made with the knowledge that whoever, in any matter within the jurisdiction of the Patent and Trademark Office, knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact, or makes any false, fictitious or fraudulent statements or representations, or makes or uses any false writing or document knowing the same to contain any false, fictitious or fraudulent statement or entry, shall be subject to the penalties including fine or imprisonment or both as set forth under 18 U.S.C. 1001, and that violations of this paragraph may jeopardize the validity of the application or this document, or the validity or enforceability of any patent, trademark registration, or certificate resulting therefrom.

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